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Amdt dated July 25, 2006

REMARKS/ARGUMENTS

Claim Objections – 35 U.S.C. §112

Claims 1-7 were objected to for being indefinite under the second paragraph of §112. The Examiner stated in the middle of page 2 of the current Office Action, that it was unclear whether the "openings" in Claim 1 were referring to the data itself or to a pattern that the data represents. Accordingly, Claim 1 has been amended to clarify that the openings are in a pattern that is represented by the data.

Claim 1 was further objected to because it was not clear to the Examiner whether or not "threshold intensity" refers to light absorption quality of the resist or some other exposure parameter. Note that "threshold intensity" refers to a threshold on the intensity of radiation (such as light) which passes through openings in the pattern. Claim 1 has been accordingly amended. For support, see the specification at, for example, page 3 line 2 in paragraph [0007]. The last limitation in Claim 1 has also been modified to clarify that it is the radiation to which "threshold intensity" applies.

In view of the above remarks, Applicant respectfully requests the Examiner to withdraw the §112 rejection of Claim 1.

At the bottom of page 2 of the current Office Action, the Examiner suggested that Claims 2 and 4 be clarified by including a reference that "increasing the area" refers to an opening. Accordingly, Claim 2 has been revised to explicitly state that the area of at least one opening is increased. Applicant submits that the area of an opening is sufficiently clear when interpreted in view of the specification, e.g. at page 5 lines 3-4, page 10 lines 25-26 and page 11 lines 2-3. Claim 4 also now uses the word "opening", in accordance with the Examiner's suggestion to refer to an opening.

In view of the above remarks, Applicant respectfully requests the Examiner to withdraw the §112 rejection of Claims 2 and 4.

At the top of page 3 of the current Office Action, the Examiner indicated that Claim 3 is unclear because it is the light passing through the opening which has the "intensity" and not the opening itself. Accordingly Claim 3 is amended to clarify that the intensity is of radiation passing through the opening. Hence, the Examiner is requested to withdraw the §112 rejection of Claim 3.

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Applicant further submits that Claim 5 as originally filed already recited "intensity of radiation". Hence, this claim is unlikely to be interpreted to mean that the opening itself has "intensity". Instead, this claim explicitly states that the intensity is of radiation. Therefore, no change is believed to be necessary, for Claim 5. Similarly no changes are believed to be required to Claims 6 and 7. If any change should still be required, the Examiner is requested to identify the change more explicitly in the next Office Action.

Claim Rejections – 35 U.S.C. §102

Claims 1-7 were rejected under 35 U.S.C. §102 (b) as being clearly anticipated by Tsudaka's US Patent 5,825,647. The Examiner explained the rejection in the bottom half of page 3 of the current Office Action merely by quoting text from Tsudaka's claims 1-11 as follows.

Tsudaka teaches (see claims 1-11) a method for correcting a mask pattern in which the mask pattern of a photomask to be used in a photolithographic step is deformed so that a transfer image near a desired design pattern is obtained, comprising the steps of: arranging a plurality of evaluation points along an outer periphery of the desired design pattern;

simulating the transfer image to be obtained where exposure is carried out under predetermined transfer conditions by using a photomask of the design pattern based on the evaluation points;

comparing a difference between the simulated transfer image and the design pattern for every evaluation point; and

deforming the design pattern according to the difference compared for every evaluation point so that the difference becomes smaller.

And wherein in the simulation step, two-dimensional light intensities on a substrate are calculated based on the design pattern and exposure conditions;

effects of the light intensities at a plurality of peripheral positions on exposure energy at an arbitrary position are calculated and cumulatively added based on the light intensities at the peripheral positions of that arbitrary position on the two-dimensional plane of the substrate and the distance between that particular position and the peripheral positions, whereby a latent image formation intensity at that arbitrary position is calculated on the two-dimensional plane of the substrate; and further comprising the steps of: finding a distribution of the latent image formation intensities on the two-dimensional plane of the substrate;

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determining a threshold value of the latent image formation intensity corresponding to the amount of exposure and development conditions;

finding contour lines at the threshold value for the distribution of the latent image formation intensities; and calculating the pattern defined by the contour lines as a transfer image.

And wherein target points are set corresponding to the evaluation points positioned at convex corners or concave corners of the design pattern, the target points are determined inside the corner at the convex corners, and the target points are determined outside the corner at the concave corners.

As seen from the above-quoted text, the Examiner failed to provide a pin-point citation in Tsudaka's patent for each limitation of each claim of the current application. Specifically, the above-quoted explanation supplied by the Examiner, is not informative because a one-to-one correspondence has not been made between Applicant's claim limitations and corresponding citations in Tsudaka's patent. Moreover, seven different claims of the current application were grouped together and rejected for a single reason, i.e. only the above-quoted explanation. Accordingly, the above-quoted explanation constitutes an "omnibus" rejection, which is impermissible. Therefore, the Office Action is defective and another non-final Office Action must be supplied so Applicant can respond appropriately. The next Office Action should provide an individual citation in Tsudaka's patent, for each claim limitation in each of Applicant's claims.

Claim 1 is believed to be not anticipated by Tsudaka's patent for a number of reasons which are discussed next.

Firstly, the Examiner has failed to show that Tsudaka discloses mask openings that are too small to print. Claim 1 requires identifying as critical openings those openings in the complementary mask that are too small to print, due to intensity of radiation passing therethrough being ineffective in exposing unwanted photoresist. For support, see Applicant's specification, e.g. at paragraphs [0009], [0012] and [0015]. If the Examiner continues to use Tsudaka in the next Office Action, Applicant respectfully requests the Examiner to supply a pin point citation in Tsudaka's patent for this limitation in Claim 1.

Secondly, the Examiner has failed to show that Tsudaka discloses improving effectiveness of too-small-to-print openings by modifying them to ensure that each opening

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provides at least the threshold intensity. Instead, Tsudaka appears to assume that all his openings generate contours, i.e. they are all printable. This is seen from the above-quoted text wherein Tsudaka requires finding contour lines at the threshold value for the distribution of latent image formation intensities; and calculating the pattern defined by the contour lines as a transfer image. If the Examiner continues to use Tsudaka in the next Office Action, Applicant respectfully requests the Examiner to supply a pin point citation in Tsudaka's patent which describes identifying too-small-to-print openings.

Thirdly, when Tsudaka's teachings are applied to a complementary mask having openings that are too small to print, the openings are likely to have no corresponding contour lines in Tsudaka's transfer image. For further explanation, see regions 103A, 103D and 103G which are shown as dotted lines in Applicant's FIG. 1C and the related description in paragraph [0009] at the bottom of page 3 of the specification. In the absence of contour lines in the transfer image, Tsudaka appears to be silent, as to what (if any) steps are to be performed. Tsudaka fails to address too-small-to-print openings. In contrast, Claim 1 requires modifying data which represents an opening in the complementary mask's pattern, in any manner that would allow radiation of at least a threshold intensity to pass therethrough, so as to be effective in erasing unwanted photoresist which results from use of the phase shifting mask.

Fourthly, even assuming that the Examiner takes the position that Tsudaka's correction method is applicable to too-small-to-print openings, Tsudaka at most teaches a correction method that uses a difference between a simulated transfer image and the design pattern at every evaluation point. See Tsudaka's FIGs. 3A and 3B which show use of a difference in location at each evaluation point, to decide how much to deform a design pattern. Hence, Tsudaka uses threshold intensity merely to generate the contour lines from which spatial deviation of the design pattern is measured. The Examiner has not cited anything in Tsudaka's patent which teaches deforming openings (which lack contours) to provide radiation of at least threshold intensity, as per Claim 1. As noted, Tsudaka's threshold intensity appears to be limited to generation of contours, nothing else.

For one or more of the above-discussed reasons, Applicant respectfully requests the Examiner to withdraw the anticipation rejection of Claim 1, and also of Claims 2-7

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which depend from Claim 1. Note that Claims 2-7 contain additional limitations, against which the Examiner failed to cite any teachings in Tsudaka's patent.

For example, Claim 4 requires moving an edge that does not abut a feature to be printed while maintaining unmoved any edge that abuts the to-be-printed feature. For support, see the specification at paragraphs [0014], [0027], [0036], [0041] and [0042]. The Examiner has failed to supply a pin point citation in Tsudaka's patent which teaches this claim limitation, i.e. selective movement of an edge depending on whether or not it abuts a feature to be printed. Hence, Claim 4 is believed to be patentable for at least this additional reason.

Moreover, Claim 7, requires simplifying a complex shape into a basic shape having fewer sides. See the specification at paragraphs [0048] - [0050], [0036], [0041] and [0042]. The Examiner has failed to supply a pin point citation in Tsudaka's patent against this limitation. In fact Tsudaka appears to teach away, by introducing more complex shapes as shown in Tsudaka's FIGs. 3A and 3B (rectangle 32 in FIG. 3A is apparently changed into the complex polygon of FIG. 3B). Hence, Claim 7 is believed to be patentable, and allowance thereof is respectfully requested.

Claim Rejections – 35 U.S.C. §103

Claims 1-7 were also rejected under 35 U.S.C. §103(a), for being obvious over the teachings of Bula in US Patent 6,383,719 or Sugita in US Patent 6,534,242 in view of Tsudaka's US Patent 5,825,647 (which is discussed above). The Examiner explained the use of Bula's teachings in the middle and bottom half of page 6 of the current Office Action as follows.

Bula et al. teach fine feature lithography is enhanced by selectively providing exposures to correct for effects such as foreshortening, corner rounding, nested to isolated print bias, feature size dependent bias, and other image biases in semiconductor processing. These results are achieved by increasing the local exposure dose in critical areas of specific images, such as line ends and corners.

The use of second block opaque mask (containing opaque regions overlapping the ends of the opaque regions of the first mask) is exposed with the low dose (10-20% of the conventional exposure) needed to fully activate those portions of the resist

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other than those blocked by both masks. The same result occurs as with the clear opening approach described herein above. One can tailor the resulting exposure to achieve a more optimal distribution light intensity with two masks than with one mask, whether one uses two masks with complementary opaque regions or two masks with complementary clear regions. These two cases apply for both positive tone resist and for negative tone resist.

Note that the above-quoted remarks by the Examiner do not address the four distinctions discussed above with regard to Tsudaka's patent. Accordingly, these same four distinctions also distinguish Claims 1-7 over Bula's teachings.

Furthermore, Applicant respectfully notes that in the above remarks the Examiner failed to provide any citation whatsoever in Bula's patent other than to cite this patent as a whole. Therefore, the above-quoted explanation supplied by the Examiner, is not informative because a one-to-one correspondence has not been made between Applicant's claim limitations and corresponding citations in Bula's patent. Accordingly, the above-quoted explanation constitutes an "omnibus" rejection, which is impermissible. Therefore, the Office Action is defective and another non-final Office Action must be supplied so Applicant can respond appropriately. The next Office Action should provide an individual citation in Bula's patent, for each claim limitation in each of Applicant's claims.

The Examiner explained the use of Sugita's teachings starting at the very bottom of page 6 of the current Office Action as follows.

Sugita et al. teach (see claims 91-92) a pattern forming method including exposure of a resist and development of the same, said method comprising: a first exposure amount distribution with an exposure amount not greater than an exposure threshold value of the resist, on the basis of periodic pattern exposure; and a second step for applying, to the resist, a second exposure amount distribution including a first portion with an exposure amount not being equal to zero but being not greater than the exposure threshold value and a second portion with an exposure amount not less than the exposure threshold value, by use of a mask having a pattern analogous to the pattern, wherein a portion of the pattern is formed on the basis of a portion of the first exposure amount distribution to be superposed with the first portion of the second exposure amount distribution, and wherein another portion of the pattern is formed on the basis of the second portion of the second exposure amount distribution to be superposed with another portion of the first exposure amount distribution.

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Note that the above-quoted remarks by the Examiner do not address the four distinctions discussed above with regard to Tsudaka's patent. Accordingly, these same four distinctions also distinguish Claims 1-7 over Sugita's teachings.

Once again, Applicant notes that the above-quoted explanation supplied by the Examiner, is not informative because a one-to-one correspondence has not been made between Applicant's claim limitations and corresponding limitations in Claims 91 and 92 which are being cited from Sugita's patent. Accordingly, the above-quoted explanation also constitutes an "omnibus" rejection, which is impermissible. Therefore, the Office Action is defective and another non-final Office Action must be supplied so Applicant can respond appropriately. The next Office Action should provide an individual citation in Sugita's patent, for each claim limitation in each of Applicant's claims.

The Examiner states in the middle of page 7 of the current Office Action that Bula and Sugita fail to teach that a complementary mask "can be improved if intensities in an aerial image from openings in the complementary mask that are below threshold are increased to ensure that each opening meets or exceeds threshold." However, the Examiner did not supply any citation whatsoever on Tsudaka's patent which supplies this teaching (which is admittedly missing from Bula and Sugita). Instead the Examiner merely stated as follows.

Tsudaka is included here as discussed above.
It would have been obvious to one having ordinary skill in the art to take the teachings of Bula et al. or Sugita et al. and combine them with the teachings of Tsudaka in order to make the claimed invention because it would have been obvious to one to adjust the size and configuration of the openings in the exposure with the second mask in order to make the claimed invention because Tsudaka amply teaches the advantages of exposure at the threshold intensity.

Note that the above-quoted explanation supplied by the Examiner, is not informative because a citation has not been provided to Tsudaka's patent. Specifically, the Examiner has not shown the column and line number where does Tsudaka teach the Examiner's statement that the complementary mask "can be improved if intensities in an aerial image

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from openings in the complementary mask that are below threshold are increased to ensure that each opening meets or exceeds threshold".

In view of the above remarks, reconsideration and withdrawal of this Office Action is respectfully requested. New Claims 24 and 26 are based on limitations recited in originally-filed Claims 4 and 7 and are believed to be likewise patentable.

For the above reasons, Applicant respectfully requests allowance of all pending claims. Should the Examiner have any questions concerning this response, the Examiner is invited to call the undersigned at (408) 982-8203.

CERTIFICATE OF FACSIMILE TRANSMISSION

I hereby certify that this correspondence is being facsimile transmitted to the U.S. Patent and Trademark Office to the fax number 571-273-8300 on July 25, 2006.


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July 25, 2006
Date of Signature

Respectfully submitted,



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